

# Producing Course Materials for Electrical Engineering Instruction Using Corel Draw 3.0

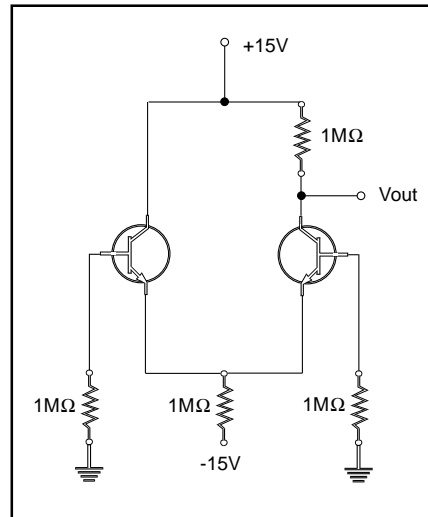


Fig. 0

Terry O'Connor and Richard Kopp  
Purdue University Statewide Technology  
New Albany, IN 47150

## Introduction

This paper gives the reader a start in creating their own course materials using an inexpensive and easily used software. By using a suitable graphics creation program drawings can be easily integrated into word processing text. The drawings integrated into text can be used in the form of tests, instructional aids, overhead projections, coursework assignments, and tutorials. By properly utilizing these various coursewares instructional quality can be improved. This paper gives the reader the basic instruction needed to get started in creating their own courseware using Corel Draw 3.0.

This exercise is in the step-by-step form. It is intended to be suitable both as an instructional aid for the learner to be guided through by the authors and as a stand alone tutorial . After completion of the following exercise, the user will have created the Figure 0 above and exported it to a wordprocessing software. The user should gain sufficient knowledge through this exercise to begin drawing schematics on their own and creating useable Electrical Engineering courseware.

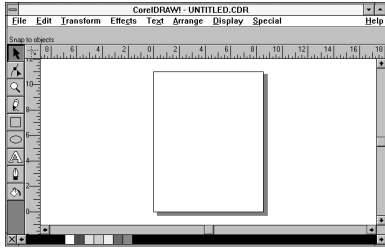


Fig. 1

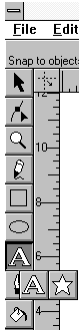


Fig. 2

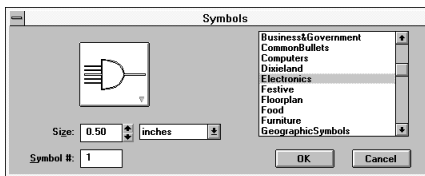


Fig. 3

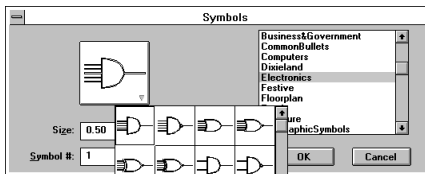


Fig. 4

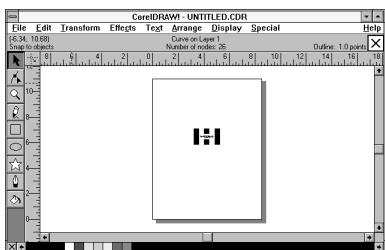


Fig. 5

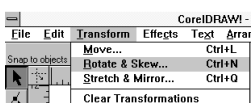


Fig. 6

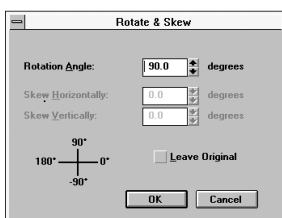


Fig. 7

## Getting Started

The drawing of Figure 0 is our finished product. We will proceed step-by-step in creating the differential amplifier schematic.

1. Open the Corel Draw 3.0 program by double clicking on the Corel Graphic group icon. Then double click on the Corel Draw icon. This will bring up a portrait orientated page 8 1/2 X 11 inches. The screen should look as it does in **Figure 1**.

2. Begin by placing a resistor on the page. Select the text symbol (the Large A) and hold down on the mouse button until both the A symbol and Star symbol fly out. Select the Star icon by clicking on it. **Figure 2** shows what you should see happening on the tool bar.

3. The cursor now appears in the form of crosshairs. Click the mouse while the crosshair is approximately centered on the page. The symbols screen will now appear as shown in **Figure 3**.

4. Select the electronics category on the far right by clicking the mouse on the word electronics. The screen will look as it does in **Figure 3**. A pictorial of a 5 input AND gate will appear, click on the five input AND gate once.

5. The library of symbols will pop-out as shown in **Figure 4**. We want to select the resistor. We do so by clicking on the resistor symbol. The resistor symbol now appears where the five input AND gate was previously.

6. We need to change the size of the symbol; it is presently at 0.5 inches. To increase it to 1.0 inch click the mouse on the up arrow on the size box. When this is done click on OK.

7. The resistor will now appear on the page.

8. We are now going to use the pick tool. To select the pick tool click the mouse on the arrow icon on the tool bar. (It is the uppermost icon in the tool bar)

9. Notice that the resistor has eight black boxes around it indicating that the part is SELECTED. The selected status of the part means that it is ready to be modified in regards to its size, position, orientation or other facet. The screen should look as it does in **Figure 5**.

10. To use the resistor in the drawing of the differential amplifier, its orientation must be changed to vertical. Click the mouse on the transform menu. Then click on the rotate and skew sub-menu as shown in **Figure 6**.

11. The rotate and skew screen will appear (see **Figure 7**). Click the arrow key on the rotation angle to positive 90 degrees. Then click on OK.

12. The diff amp uses four vertically oriented resistors so we will now duplicate the resistor that we have, three times. Before we actually perform the duplication, we need to set a PREFERENCE. We select the SPECIAL menu. On the sub-menu, we then select the Preferences sub-menu

by clicking the mouse on preference. See **Figure 8** for reference.

**13.** The Preference screen will appear as it does in **Figure 9**. In the Place Duplicate area, use the arrow key on the horizontal setting to a positive 1.00 inch.

**14.** Change the vertical to 0.00 if it is not already at 0.00 inches. Click the mouse on OK.

**15.** A duplication of a selected part is done by clicking on the EDIT menu. When the EDIT menu is selected then click the mouse on the Duplicate command. See **Figure 10**.

**16.** A second resistor appears on the page. Repeat the duplicate command by selecting the EDIT menu and then the DUPLICATE sub-menu two more times. There should now be four resistors on the page as shown in **Figure 11**.

**17.** Click the mouse on the Star (graphic tool). Place the cross hair on the page above the resistors. The symbols screen will now appear on the monitor. Click on the five input AND gate once, and scroll down through the pop-up display by clicking the mouse on the down arrow. Continue scrolling down until the NPN BJT schematic symbol is displayed on the pop-up display.

**18.** Click on the NPN BJT symbol. The screen should look as it does in **Figure 12**. Now click on OK.

**19.** Select the PICK tool from the tool bar by clicking on its icon. Notice how the transistor is selected as the eight boxes surrounding it indicate.

**20.** To duplicate the transistor we will now use a keyboard command. The duplicate command can be executed by holding down the CTRL key and simultaneously depressing the 'D' key, this is referred to as the CTRL-D command. Depress the CTRL key and the 'D' key. The transistor will be duplicated one inch horizontally away from the first transistor.

**21.** The second transistor in the diff amp needs to be mirrored. Click the mouse on the Transform menu. Now, click the mouse on the Stretch & Mirror sub-menu. The Stretch & Mirror display will pop-out. Click on the Horizontal mirror (see **Figure 13**) and then click on OK.

**22.** In order to properly align the drawing we need to use guidelines. Guidelines are lines used to align a drawing, but are not visible on the printed graphic.

**23.** Notice on both the horizontal and vertical borders of the drawing window that there are rulers. Move the mouse arrow into the vertical ruler, click and hold the mouse button while dragging the mouse to the center of the page. Stop dragging when the blue dashed vertical line is on the 4 1/4 inch mark as indicated on the horizontal ruler. Release the mouse button. The vertical dashed blue line is a guideline.

**24.** We will now create a horizontal guideline. Move the mouse arrow

Fig. 8

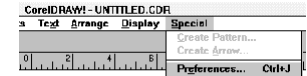


Fig. 9

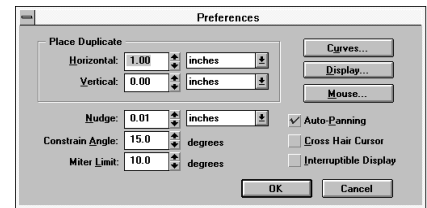


Fig. 10

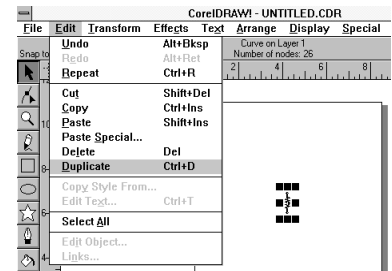


Fig. 11

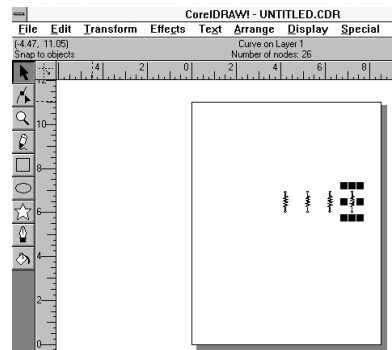


Fig. 12

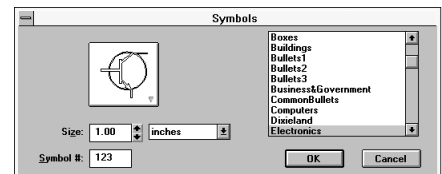
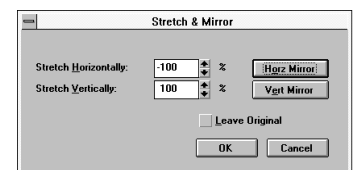


Fig. 13



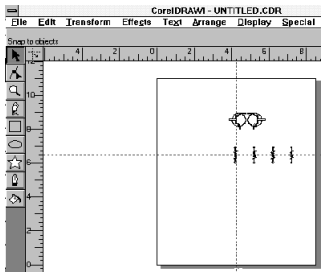


Fig. 14

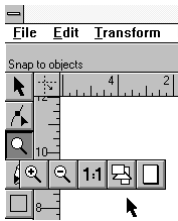


Fig. 15

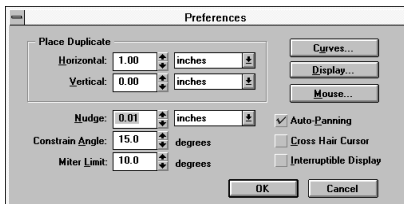


Fig. 16

into the horizontal ruler; click and hold the mouse while dragging the mouse to the center of the page. Stop dragging the mouse when the blue dashed line is on the 6 1/2 inch mark of the vertical ruler. Release the mouse button. The drawing should now appear as it does in **Figure 14**.

**25.** In order to get a closer look at our work we will now use a zoom command. Click the mouse magnifying glass icon (zoom tool). The Zoom tool menu will fly-out. Click the mouse on the symbol indicated by the arrow in **Figure 15**, this is the "Fit in Window" icon. The monitor will display the closest view possible while keeping all the objects on the page.

**NOTE:** You may find it necessary to use the zoom tool to either zoom-in on part of the drawing or to zoom-out. Use the fit-in-window selection on the zoom tool or zoom-out tool (the magnifying glass with the negative sign in it) as you deem appropriate.

**26.** We are now going to create some more guidelines that will allow us to accurately place the parts on the drawing. We will begin by placing four additional vertical guidelines. Move the arrow to the vertical ruler and drag the mouse to the 2 1/2 inch mark as indicated by the horizontal ruler. Release the mouse button. Create three vertical guidelines in likewise fashion at 3 1/4 inches, 5 1/4 inches, and 6 inches. If your screen does not show any of the desired inch marks on the vertical ruler, scroll the screen over using the window adjustment arrows on the bottom of the screen (this is done in the same manner as in any windows application.) In addition, we need to create two more horizontal guidelines. Click and drag the mouse in the horizontal ruler and bring the guideline to the 9 inch mark on the vertical ruler. Make another guideline in the same manner at the 5 1/2 inch mark. Remember to scroll the screen to the appropriate area if necessary.

**27.** With the guidelines in place we will now begin to place the parts so that drawing resembles the original. To more precisely place parts we are going to utilize the nudge command. The nudge command allows the part selected to be moved in the direction of the cursor arrow selected on the keyboard by a specified distance. We are going to set the nudge command to increments of .01 inches. To do this, select the special menu with mouse and then the preferences sub-menu. The preferences screen will be shown on the monitor as it appears in **Figure 16**. Adjust the nudge setting to 0.01 by clicking the mouse on the up or down arrow as appropriate. After this is done, click on OK.

You may find it necessary to zoom back at this point so that more of the drawing area may be viewed. To zoom back click the mouse on the magnifying glass in the tool bar (zoom tool) and when the pop-out display appears, click the mouse once on the magnifying glass with the negative sign in it.

**28.** Select the Pick tool from the tool bar. We are going to move the resistor. Point the pick tool on one of the resistors and while holding the mouse key down drag the resistor so that its top is on the intersection of the 5 1/2 inch horizontal guideline and the 2 1/2 inch vertical guidelines. Release the mouse button when the part is close to the intersection of the lines.

Use the arrow keys on the keyboard to nudge the part into place. A vertical arrow causes vertical movement, the left arrow left movement, etc.

**29.** Select a second resistor and place its top at the intersection of the 5 1/2 inch horizontal guideline and the 4 1/4 inch vertical guideline. Nudge the part into more precise placement.

**30.** Select a third resistor and place it near the 5 1/2 inch horizontal guideline and the 6 inch vertical guideline.

**31.** Select the transistors which has the left facing base lead. Move the transistor by dragging it over to the 6 1/2 inch horizontal guideline and allow the emitter lead snap to the guideline. Use the arrow keys to nudge the transistor so that its collector and emitter lead are aligned on the 3 1/4 inch vertical guideline.

**32.** Select the transistor with the right facing base lead and move it until its emitter lead snaps to the 6 1/2 inch horizontal guideline. Nudge the part into place so that the collector and emitter leads align on the 5 1/4 inch vertical guideline.

**33.** Move the fourth resistor so that its top is near the intersection of the 5 1/4 vertical line and the 9 inch horizontal guideline. Nudge the resistor into position using the arrow keys.

**34.** We will now draw connecting lines. To do this we select the pencil tool from the tool bar. See **Figure 17**. Click on the pencil tool icon with the mouse. Place the cross hairs on the emitter lead of the transistor at the intersection of 5 1/4 inch vertical line and the 6 1/2 inch horizontal line. While simultaneously holding down the CTRL key on the keyboard, click the mouse once and move the crosshairs down vertically to the intersection of the 5 1/2 horizontal and 5 1/4 vertical guidelines and click the mouse once.

**35.** To continue the line, (while still holding down the CTRL key) click the mouse once and move the cross hair horizontally to the left to the intersection of the 5 1/2 inch horizontal and the 3 1/4 inch vertical guidelines. Click the mouse once.

**36.** Click the mouse once while holding down the CTRL key and move the crosshair up vertically to the intersection of the 6 1/2 inch horizontal line and the 3 1/4 vertical guideline. Click the mouse once. The drawing should now appear as it does in **Figure 18**.

**37.** Move the crosshairs to the collector lead of the left transistor. Click the mouse once and move upward vertically to the intersection of the 9 inch horizontal guideline and the 3 1/4 inch horizontal guideline. Click the mouse once.

**38.** To continue the line click the mouse again (still holding down the CTRL key) and move the crosshair to the intersection of the 9 inch horizontal and the 5 1/4 vertical guidelines. Click the mouse once.

**39.** Move the crosshair to the bottom of the resistor above the collector

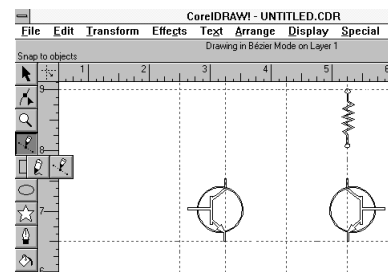


Fig. 17

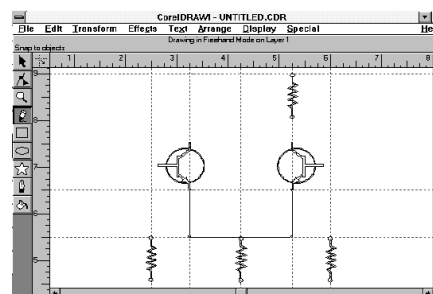


Fig. 18

lead of the right transistor. Hold down the CTRL key. Click the mouse once and move the mouse crosshair to the collector of the right transistor and click the mouse once.

**40.** Move the crosshair to the top of the left most resistor (at the intersection of the 2 1/2 inch vertical and 5 1/2 inch horizontal guidelines) and click the mouse once. Move the mouse upward vertically along the 2 1/2 inch vertical guideline until the horizontal portion of the crosshair is aligned evenly with the base lead of the left transistor. Click the mouse once.

**41.** In drawing this next line segment we are going to use a previously unused line drawing command. While holding down both the ctrl and shift keys on the keyboard, click the mouse once and move the crosshair to the base lead of the transistor and click the mouse once. Holding the down the control and shift keys simultaneously allows the drawer to make horizontal lines that connect to the center of the lead rather than to one side of the component's lead.

**42.** We are going to draw the lead connections for the right transistor. In the same manner as done with the left transistor's base lead, draw the lines from the right most resistor to the base lead of the right transistor. The drawing should now look as it does in **Figure 19**.

**43.** We will now add the common symbol to the schematic. Click the mouse on the graphic symbol in the tool bar. Move the cross hair to an open portion of the page and click the mouse once.

**44.** The symbols screen will now appear. Click on the five input AND gate. Scroll down through the available electronic symbols until the common symbol is located. Select the common symbol by clicking on it once with the mouse.

**45.** The common symbol needs to have its size adjusted to 0.5 inch. Do so by clicking on the down arrow of the size box until it reads 0.5. Click on OK.

**46.** Since we need two common symbols, type CTRL-D to duplicate it. There should be two common symbols side-by side on the screen.

**NOTE:** You may find it necessary to use the zoom tool to either zoom-in on part of the drawing or to zoom-out. Use the fit-in-window selection on the zoom tool or zoom-out tool (the magnifying glass with the negative sign in it) as you deem appropriate.

**47.** Select the Pick tool by clicking on it in the tool bar. Select one common symbol by clicking and holding on it (dragging). Move the symbol so that its top touches the bottom of the resistor in the right transistor's base lead. Use the arrow keys on the keyboard to nudge the part into place.

**48.** Select the second common symbol and move it so that its top touches the bottom of the resistor in the left transistor's base lead. Nudge the symbol into place.

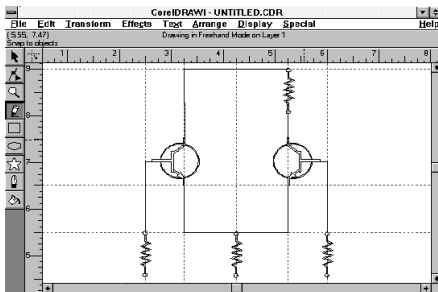


Fig. 19

**49.** We are now going to draw in the Vout line. Select the pencil tool from the tool bar. Move the cross hair midway between the collector of the right transistor and the collector resistor. Click the mouse once and hold down both the ctrl and shift keys on the keyboard. Move the mouse directly right to the six inch vertical guideline and click once.

**NOTE:** You may find it necessary to use the zoom tool to either zoom-in on part of the drawing or to zoom-out. Use the fit-in-window selection on the zoom tool or zoom-out tool (the magnifying glass with the negative sign in it) as you deem appropriate.

**50.** We are now going to retrieve a non-electronics symbol from the symbols library. Click the mouse once on the 'A' symbol icon in the tool bar (graphics tool) and hold down the mouse key until the 'A' and Star symbols pop-out. Click on the star symbol (graphics tool.) Move the cross hairs to the right of the line we just drew and click the mouse once. The symbols screen will appear. Move the mouse to highlight the CommonBullets group and then click the mouse on the rectangle appearing in the symbol box. A group of geometric symbols will appear, click the mouse once on the circle appearing in the top row, third box from the left. Next, resize the circle to 0.1 inch and then click on OK. A empty circle will appear on the screen.

**51.** Move the circle using the pick tool to the end of the Vout line and nudge it into place using the arrow keys.

**52.** Since we will need three more circles on the schematic we will duplicate the circle using the CTRL-D command. A second circle will appear to the right of the original circle. This circle needs to have its center black as used to indicate a connection on a line in the schematic. To do so, click the mouse once on the paint bucket icon in the tool bar. (See **Figure 20**) The paint bucket pop-out screen will appear. Click the mouse once on the black box. This will fill-in the circle black.

**53.** Use the pick tool to move the black circle to the connection point on the collector's lead and the Vout line. See the finished schematic, **Figure 0** for reference.

**54.** Use the pick tool to select the black circle just previously place on the collector lead. Type CTRL-D to duplicate it. Move the duplicated circle with the pick tool to the top of the tail resistor and nudge it into precise placement using the arrow keys.

**55.** Next we are going to duplicate both a line and two circles simultaneously. To do this we are going to group these parts with the pick tool. The Vout line, the black circle on its left end and the unfilled circle on its right end can be duplicated as a group item by selecting the black circle. Then while holding down the SHIFT key, click the mouse once on the Vout line and then continue holding down the shift key and click the mouse once again on the unfilled circle on the right end. Notice on the screen how the eight boxes indicating the selected part now encompass the area of the line and its two end circles.

**56.** To duplicate this entire segment, click the mouse on the Arrange menu

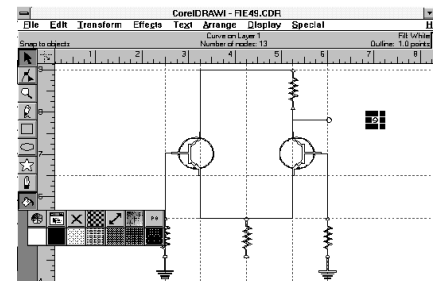


Fig. 20

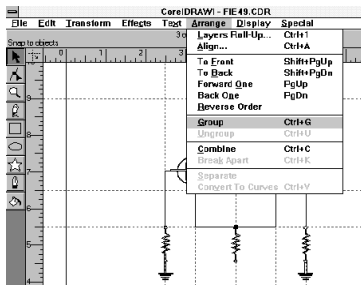


Fig. 21

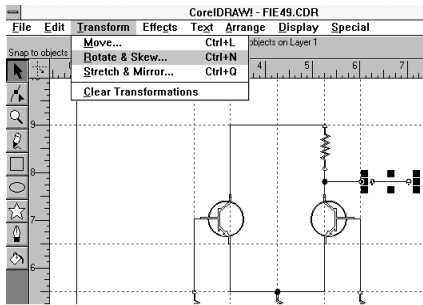


Fig. 22

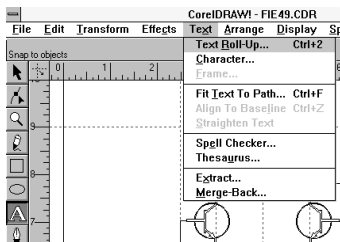


Fig. 23

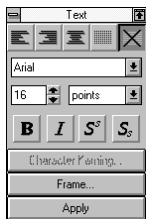


Fig. 24

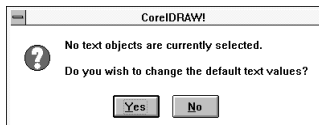


Fig. 25

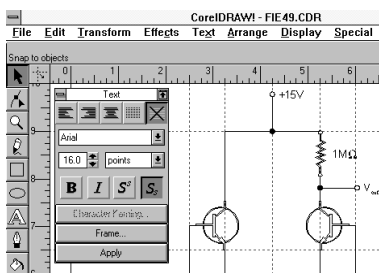


Fig. 26

and select the Group sub-menu by highlighting it. Now type CTRL-D and the entire line segment and its two circle ends are duplicated just to the right of the original. See **Figure 21** for how the screen should now appear.

**57.** We desire to place this segment on the top of the schematic for the line where the +15 V supply connects to the circuit. This segment needs to be both rotated and moved. To rotate the part, click on the transform menu and select the rotate and skew sub-menu. See **Figure 22**.

**58.** The Rotate & Skew screen will appear. Set the rotation angle to +90 degrees.

**59.** Move the part by using the pick tool to move the line segment's filled circle to the intersection of the 4 1/4 inch vertical guideline and the drawn line connecting the two collectors.

**60.** The drawing is nearly complete, we need to add some text characters and save the drawing in a suitable format for the intended word processing program. Move the mouse to the tool bar and click and hold the mouse button on the star (graphic symbol). The 'A' and the star symbol will both pop-out. Click on the 'A' (text tool) .

**61.** We need to set the type size and font for the text characters. Click on the text menu and then highlight the Text Roll-up submenu, as in **Figure 23**.

**62.** The text Roll-up screen will appear as it does in **Figure 24**. Select the font by clicking the mouse on the down arrow to the right of the font box. Scroll through the font selections to the Arial font and click on it once.

**63.** Use the mouse to adjust the type size to 16.0. Next Click on Apply. A screen will appear indicating that no text was selected and asking if you desire to change the default value. ( See **Figure 25** ) Click on Yes. All the text entered will now be in the selected font and size.

**64.** Click the mouse cross hair near the top of the line segment connected to the collectors. Type "+15V". Select the pick tool and then nudge the text into more precise placement with the arrow keys.

**65.** We will now enter the text for the '-15V' supply. See **Figure 0**, for reference on placement of the text. Click the mouse on the 'A' symbol (graphics tool .) Move the cross hair to the bottom of the tail resistor and enter '-15V'. Then select the pick tool from the tool bar and nudge the text more precisely into place.

**66.** Now we need to enter the label for the Vout line. Select the graphics tool ('A' symbol) from the tool bar. Move the cross hair into position near the right end of the Vout line segment. Click the mouse once. Type in an upper case 'V'. Move the mouse to the text roll-up and click once on the subscript symbol as shown in **Figure 26**. Now type a lower case 'out'. Select the text with the pick tool and move the text into position. Nudge it into more precise placement if necessary.



67. We need to now label the one megohm resistors. This is a slightly more complicated function as it requires both text and a symbol. Select the graphics too. ('A' symbol) Click the mouse near the collector resistor. Type '1M'. Move the mouse back to the tool bar and click on the 'A' icon and hold down on the mouse button. When the graphic symbol appears (the star), click on it. Move the mouse cross hair to the right and near the '1M'. Click the mouse once. The symbols screen will appear. Scroll down through the list of symbols on the right of the symbols screen until the GreekMathSymbols appear. Click the mouse once on it. Move the mouse over to the size box and set the size to 0.20 inches. Click on the box containing the rectangle. Scroll down through the group of symbols to the upper case omega. Click the mouse once on omega. Then click on OK. Select the pick tool and move the omega symbol into place next to the 1M.

68. The text 1M and the omega symbol are separate items. We desire to group them as one. To do so, use the pick tool then while holding down the SHIFT key click on the '1M' symbol, continue holding down the SHIFT key and select the omega symbol. Click the mouse on the Arrange menu and then highlight the Group sub-menu.

69. The entire group of the '1m" text and the omega symbol needs to be duplicated three times. To do the first duplication we type CTRL-D once. Then move the selected text and symbol near to the left base resistor.

70. Type CTRL-D once again. Use the arrow keys to nudge the text into place next to the tail resistor.

71. Type CTRL-D once again. Use the arrow keys to nudge the part into place to the right of the right base resistor.

72. The drawing is now complete. We need to now save the drawing, to do so, click the mouse once on the 'File' menu and then highlight the 'Save as' sub-menu. The SAVE Drawing screen will now appear. Click the mouse on the File Name box and type "Diffamp.cdr". Choose the drive and directory you wish to save your drawing to , then click the mouse on OK. See **Figure 27** for reference.

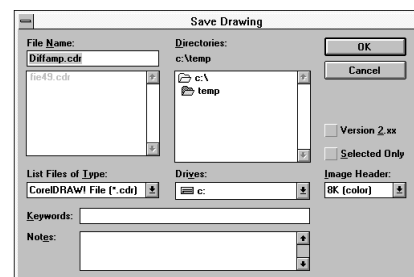


Fig. 27

73. We now must export the drawing into a format compatible with the word processor we're using. In this example we will export to WordPerfect. Click the mouse on the file menu and then highlight the Export sub-menu. The Export screen will appear. See **Figure 28**. Click the mouse once on the down arrow on the box labeled "List Files of Type:" The available type of files types to export the drawing will pop-out. Scroll down through the list of file types until "WordPerfect Graphic, \*.WPG" is visible. Highlight that file type with the mouse. Choose the drive and directory that you desire to save the drawing to. Click the mouse on OK.

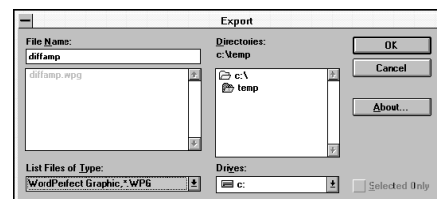


Fig. 28